# Contents

Preface . . . . . vii
Sponsors . . . . . viii
Committees . . . . . ix
Contents . . . . . xi
Opening address . . . . . xxiii
Announcement of the ICL '90 prize recipient . . . . . xxv

**PART I**

**Section 1. ICL '90 Prize lecture**

Electrical instability and dynamical processes in the excited state of ruby
A.A. Kaplyanskii . . . . . 1

**Section 2. Ferd Williams symposium**

Pressure effects on molecular and related luminescence
H.G. Drickamer . . . . . 11

Impact processes in electroluminescence
J.W. Allen . . . . . 18

Excitonic mechanism of luminescence excitation of rare-earths and transition metals in solids
M. Godlewski, K. Świątek, A. Suchocki and J.M. Langer . . . . . 23

**Section 3. Applications symposium**

Phosphors for X-ray detectors in computed tomography
W. Rossner and B.C. Grabmaier . . . . . 29

Photostimulable phosphors for X-ray imaging: applications and mechanism
M.K. Crawford and L.H. Brixner . . . . . 37

Problems and progress in cathode-ray phosphors for high-definition displays
H. Yamamoto and H. Matsukiyo . . . . . 43

Recent developments on phosphors for fluorescent lamps and cathode-ray tubes
T. Welker . . . . . 49

**Section 4. Excitons**

Time-resolved studies of excitonic polaritons
J. Aaviksoo . . . . . 57

Relaxation of excitons in organic crystals with strong exciton–phonon coupling
A. Matsui . . . . . 67

Transform-limited picosecond resonant light scattering of excitons
H. Stolz, V. Langer and W. von der Osten . . . . . 72

Exciton luminescence in $PbI_2$–$PbBr_2$ mixed crystals
J. Takeda, S. Saito and S. Kurita . . . . . 79

Excitonic diffusion and recombination processes in CuCl
M.J.M. Gomes, R. Lévy and B. Hönerlage . . . . . 83

Free and localized exciton luminescence in $Pb_{1-x}Cd_xI_2$ mixed crystals
M. Watanabe, A. Ishibashi and T. Hayashi . . . . . 87

Delay of excitonic self-trapping (bottleneck states)
H. Eiermann, A. Köngeter and M. Wagner . . . . . 91

High pressure effects on self-trapped excitons in RbI
M. Kobayashi, T. Hirose and H. Nishimura . . . . . 98

Luminescence and hyper Raman scattering due to excitonic molecules in $ZnP_2$
T. Goto and Y. Goto . . . . . 103

Luminescence associated with self-trapped excitons in LiBr
K. Fujiwara, S. Nagata, H. Nishimura, M. Nakayama, T. Komatsu and S. Hashimoto . . . . . 107

Luminescence from exciton-free carrier collisions in GaSe
V. Capozzi, L. Pavesi and J.L. Staehli . . . . . 111

Luminescence from free and self-trapped excitons in $ZnSe_{1-x}Te_x$
C.D. Lee, H.K. Kim, H.L. Park, C.H. Chung and S.K. Chang . . . . . 116

Relaxed configuration of self-trapped excitons in $Na_{1-x}K_xI$ and $K_{1-x}Rb_xI$ mixed crystals
M. Itoh, S. Hashimoto and N. Ohno . . . . . 121

Self-trapping of free excitons in mixed $K_{1-x}Rb_xI$ crystals
N. Ohno, M. Itoh, S. Hashimoto and H. Sumi . . . . . 125

Self-trapping processes of excitons in KI
T. Kishigami, K. Toyoda and T. Hayashi . . . . . 129

Temperature dependence of polariton luminescence in CuCl
H. Akiyama, M. Kuwata-Gonokami, T. Kuga, K. Kurihara and M. Matsuoka . . . . . 133

Term structure of bound excitons in cubic ZnSe:Na
G. Kudlek, A. Hoffmann, R. Heitz, C. Fricke, J. Gutowski, G.F. Neumark and R.N. Bhargava . . . . . 138

Exciton patterns in molecular dots and wires and application to polymer morphology
R. Kopelman, Z.-Y. Shi and C.S. Li . . . . . 143

Three types of emission bands from hetero-nuclear relaxed excitons in NaBr:I, KBr:I and RbBr:I
K.-I. Kan'no, K. Tanaka, H. Kosaka and Y. Nakai . . . . . 147

The transient grating as a probe for polariton dynamics
J. Knoester . . . . . 152

**Section 5. Energy transfer and other dynamic processes**

Laser processes and energy transfers
V. Lupei . . . . . 157

Fast resonant nonradiative energy transfer in alexandrite
S.A. Basun, S.P. Feofilov and A.A. Kaplyanskii . . . . . 166

Energy transfer and thermalization in YAG:Tm, Ho
G. Armagan, A.M. Buoncristiani and B. Di Bartolo . . . . . 171

Energy transfer in $Ni^{2+}$:MgO
R.J. Tonucci, S.M. Jacobsen and W.M. Yen . . . . . 175

Methyl group tunneling in molecular solids at low temperatures
C. von Borczyskowski, A. Oppenländer, H.P. Trommsdorff and J.-C. Vial . . . . . 179

Characterization of energy transport in molecular crystals by ultrametric spaces
C. von Borczyskowski and T. Kirski . . . . . 184

Intraband energy relaxation of hot carriers in CdSe
Y. Masumoto and F. Sasaki . . . . . 189

Excited state dynamics of poly-di-n-hexyl-silane
A. Tilgner, J.R.G. Thorne, J.P. Pique, J.M. Zeigler, R.M. Hochstrasser and H.P. Trommsdorff . . . . . 193

Energy transfer and dynamics of photosynthetic antenna complexes and biological model systems
H. van der Laan, Th. Schmidt and S. Völker . . . . . 199

Dynamics of proton transfer in 7-azaindole
P. Share, M. Pereira, M. Sarisky, S. Repinec and R.M. Hochstrasser . . . . . 204

Spectral and temporal dynamics of far infrared generated monochromatic nonequilibrium phonons in $LaF_3:Pr^{3+}$
W.A. Tolbert, W.M. Dennis, R.S. Meltzer, J.E. Rives and W.M. Yen . . . . . 209

Anomalously fast energy transfer between manganese and thulium in fluoride glasses
O. Maoz, S.R. Rotman, A.M. Weiss, R. Reisfeld and M. Eyal . . . . . 213

Steady-state and time-resolved studies on intramolecular proton transfer in benzotriazole and benzothiazole crystals
M. Wiechmann and H. Port . . . . . 217

Energy transfer from the higher excited state of Mn to Tm in ZnS:Mn, Tm
W. Xu, X.y. Zhang and X.r. Xu . . . . . 224

Energy transfer processes between various $Cr^{3+}$ and $Nd^{3+}$ multisites in YAG:Nd, Cr
J.A. Mares, W. Nie and G. Boulon . . . . . 227

Energy transfer in (Ca–Zr)-substituted $Gd_3Ga_5O_{12}$ single crystals doped with $Cr^{3+}$, $Tm^{3+}$ and $Ho^{3+}$ ions
A. Brenier, C. Madej, C. Pedrini and G. Boulon . . . . . 232

Excited state kinetics and energy transfer in $Pr^{3+}$ doped YAG
M. Malinowski, W. Woliński, R. Wolski and W. Stręk . . . . . 235

On the contribution of excimers to the transfer of excitation energy in liquid alkylbenzenes
R. Sasson and A. Weinreb . . . . . 239

Excitation energy migration in $Cd_{1-x}Mn_xF_2$ mixed crystals
A. Suchocki, Z. Kalinski and R.C. Powell . . . . . 243

Thermal effect on energy transfer and dissipation in heavily doped ruby
X.X. Zhang, P. Hong, B. Di Bartolo and C.W. Struck . . . . . 248

Radiative and nonradiative relaxation measurements in $Ce^{3+}$ doped crystals
L.-J. Lyu and D.S. Hamilton . . . . . 251

Optical line shapes of inhomogeneously broadened exciton transitions in the coherent potential approximation
A. Boukahil and D.L. Huber . . . . . 255

Using the emission properties of an intramolecular excimer-forming probe molecule to determine the effect of hydrostatic pressure on local polymer dynamics
B.D. Freeman, L. Bokobza, P. Sergot, L. Monnerie and F.C. De Schryver . . . . . 259

Excimer formation of hydrocarbons doped in amorphous silica glasses
T. Yamanaka, Y. Takahashi, T. Kitamura and K. Uchida . . . . . 265

Quenching of the superradiative decay by confined acoustic-phonons in CdS microcrystallites
K. Misawa, H. Yao, T. Hayashi and T. Kobayashi . . . . . 269

Vibrational relaxation by electronic energy transfer and by multiphonon processes
D. Kuszner and N. Schwentner . . . . . 273

Micrometer-domain fluorescence dynamics of xanthene dyes in polymer films
K. Kemnitz, N. Shimo, H. Masuhara, A. Fukugawa and Y. Horiike . . . . . 278

Level-crossing in chromium-doped materials
C.J. Donnelly, T.J. Glynn, G.P. Morgan and G.F. Imbusch . . . . . 283

**Section 6. Nonlinear and coherent processes**

Spontaneous emission of coherent light in highly excited media
L.O. Schwan . . . . . 289

Structure and function of photosynthetic systems studied by hole burning spectroscopy
J. Hala, M. Vacha, J. Dian, M. Ambroz, F. Adamec, O. Prasil, J. Komenda, L. Nedbal, F. Vacha and J. Mares 295

Dispersive optical bistability in ZnSe–ZnS/GaAs multiple quantum wells
D.Z. Shen, X.W. Fan, G.H. Fan and J.Y. Zhang . . . . . 299

Transient nonlinear optical phenomena in a disordered system
M. Aihara . . . . . 303

Nonlinear effects in microcrystalline semiconductors
B. Andrianasolo, B. Champagnon, M. Ferrari and N. Neuroth . . . . . 306

Nuclear spin-flip sidebands in optical spectral hole burning and fluorescence line narrowing of the $Er^{3+}$ ion
R. Wannemacher, R.M. Macfarlane, Y.P. Wang, D. Sox, D. Boye and R.S. Meltzer . . . . . 309

Nonexponential photon echo decay of $Er^{3+}$ in fluorides
R.M. Macfarlane, R. Wannemacher, D. Boye, Y.P. Wang and R.S. Meltzer . . . . . 313

Analysis of the $^8S_{7/2} \rightarrow {}^6P_J$ two-photon absorption transitions of $Gd^{3+}$ in $Cd_2NaGdCl_6$
M. Bouazaoui, B. Jacquier, C. Linarès, W. Stręk and R.L. Cone . . . . . 318

Linear and nonlinear optical properties of quasi one-dimensional excitons in conjugated polymer polydiacetylenes
T. Koda, T. Hasegawa, K. Ishikawa, K. Kubodera, H. Kobayashi and K. Takeda . . . . . 321

Nonlinear absorption and laser-induced gratings in glasses doped with acridine orange and methyl orange
S. Graham, M. Eyal, M. Thoma, D. Brusilovsky, R. Reisfeld and C. Klingshirn . . . . . 325

Spectral hole burning and holography IV Reconstruction symmetry of the hologram efficiency
K. Holliday, C. Wei, A.J. Meizner and U.P. Wild . . . . . 329

Molecular computing
U.P. Wild, C. De Caro, S. Bernet, M. Traber and A. Renn . . . . . 335

**Section 7. Organic and biological systems**

Luminescence of porphyrins
S.M.B. Costa, M.M. Velázquez, N. Tamai and I. Yamazaki . . . . . 341

Fluorescence and lasing properties of rhodamine dyes
J. Arden, G. Deltau, V. Huth, U. Kringel, D. Peros and K.H. Drexhage . . . . . 352

Fluorescence properties of heterocyclic aromatic diether derivatives and their polymers
Y. Belabbes, J.J. Aaron, H. Mir-Hedayatullah, S. Aeiyach and P.C. Lacaze . . . . . 359

Electronic and fluorescence properties of 2, 3-diphenyl indole
A. Arena, G. Martino, A.M. Mezzasalma, G. Mondio and G. Saitta . . . . . 363

Investigation of photoluminescence in poly(paraphenylene)
C.Q. Jin, S.Z. Lu, E. Rzepka and S. Lefrant . . . . . 368

Luminescence associated with the molecular aggregation of hydrocarbons in doped amorphous silica glasses
T. Kitamura, Y. Takahashi, T. Yamanaka and K. Uchida . . . . . 373

Reabsorption effect on the fluorescence spectra and the libration of the phenyl ring in p-terphenyl crystals
K. Uchida, S. Sato and Y. Takahashi . . . . . 377

Vibrational analysis on the fluorescence spectrum of p-terphenyl in the crystalline low-temperature phase
C. Kryschi, W. Klüfer and H. Kupka . . . . . 381

Absorption coefficients and fluorescence quantum yields of porphyrin films determined by optical and photoacoustic spectroscopies
J.A. Ferreira, R. Barral, J.D. Baptista and M.I.C. Ferreira . . . . . 385

Heat-pulse modulated phosphorescence spectra of 9-xanthone at low temperature
M. Koyanagi and T. Terada . . . . . 391

Fluorescence quantum yield evaluation of strongly absorbing dye solutions as a function of the dye concentration
L.F. Vieira Ferreira and S.M.B. Costa . . . . . 395

Luminescence properties of rhodamines in water/ethanol mixtures
T. López Arbeloa, M.J. Tapia Estévez, F. López Arbeloa, I. Urrexta Aguirresacona and I. López Arbeloa . . 400

Measurements of the resonance fluorescence spectrum in dye-doped amorphous systems
J.S. Ahn, Y. Kanematsu and T. Kushida . . . . . 405

Fluorescence from the primary products of the bacteriorhodopsin photocycle
G.H. Atkinson, D. Blanchard and T.L. Brack . . . . . 410

Picosecond timeresolved investigation of singlet energy transfer in porphyrin hetero dimers
U. Rempel, B. von Maltzan and C. von Borczyskowski . . . . . 415

Intracellular distribution of ellipticine, an antitumor alkaloid in K562 leukemia cells
M.A. Schwaller, F. Sureau, P.Y. Turpin and J. Aubard . . . . . 419

Picosecond kinetic studies of charge separation in 9, 9′-bianthryl as a function of solvent viscosity and comparisons with electron transfer in bacterial photosynthesis
H. Lueck, M.W. Windsor and W. Rettig . . . . . 425

Global analysis of wavelength-resolved fluorescence decay in sarcoplasmic reticulum calcium–ATPase
S.T. Ferreira and S. Verjovski-Almeida . . . . . 430

Spectrofluorimetric analytical investigation of 1-(4-aminophenyl)-4-methyl-7, 8-dimethoxy-5H-2, 3-benzodiazepine
I. Hornyák, I. Kása, L. Kozma, J. Körösi and P. Botka . . . . . 435

Spectrofluorimetric analytical investigation of psoralens on adsorbents
L. Kozma, I. Hornyák and L. Székelyhidi . . . . . 438

Polarized luminescence and structure of Van der Waals complexes of organic molecules
N.A. Borisevich, V.A. Povedailo and V.A. Tolkachev . . . . . 441

Influence of pressure on cyclization of a polystyrene chain
A.T. Reis e Sousa, J.M.G. Martinho, F. Baros, J.C. André and M.A. Winnik . . . . . 445

Absorption and emission spectroscopy on chlorofluorocarbons in noble-gas matrices
M. Creuzburg, P. Zangl and H. Vaith . . . . . 449

Reversible monomer–excimer kinetics in solution
M.N. Berberan-Santos, J.P. Pinheiro, J.P. Farinha and J.M.G. Martinho . . . . . 456

Indexes to parts I and II . . . . . XXVII

**PART II**

**Section 8. Rare earth ions in insulators**

Linear and nonlinear spectroscopy of $Eu^{3+}$ in crystals
M. Mitsunaga and N. Uesugi . . . . . 459

Lanthanide luminescence in supramolecular species
N. Sabbatini, A. Mecati, M. Guardigli, V. Balzani, J.-M. Lehn, R. Zeissel and R. Ungaro . . . . . 463

Density of states and energy levels of $BaF_2:Sm^{2+}$ using nonrelativistic and relativistic cluster models
C.x. Guo, S. Chang and S.d. Xia . . . . . 469

$^5D_0$–$^7F_0$ transition mechanism of $Eu^{3+}$ in $Ca(PO_3)_2$ glass, $Y_2O_2S$ crystal and polyvinyl alcohol
G. Nishimura, M. Tanaka, A. Kurita and T. Kushida . . . . . 473

Comparison of the spectra and dynamics of $Er^{3+}:Y_{2-x}Sc_xO_3$ ($x$=0, 1, 2)
B.M. Tissue, N.J. Cockroft, L. Lu, D.C. Nguyen and W.M. Yen . . . . . 477

Photostimulated luminescence process in $BaFBr:Eu^{2+}$ containing $F(Br^-)$ and $F(F^-)$ centers
Y. Iwabuchi, C. Umemoto, K. Takahashi and S. Shionoya . . . . . 481

Saturation by resonant up-conversion in Tb-doped phosphors
R. Raue, K. Nieuwesteeg and W. Busselt . . . . . 485

High pressure effect on the luminescence spectra of $Eu^{3+}$ in stoichiometric host microcrystals
C.x. Guo, B.l. Li, Y.f. He and H.b. Cui . . . . . 489

Vibronic transition probabilities of $Gd^{3+}$
J. Sytsma, W. van Schaik and G. Blasse . . . . . 494

Optical study of $Eu^{3+}$ luminescence in lithium rare earth borates, $Li_6RE(BO_3)_3$; RE=Gd, Y
J. Hölsä and M. Leskelä . . . . . 497

Photoconductivity and fluorescence properties of divalent ytterbium ions in fluoride crystals
B. Moine, B. Courtois and C. Pedrini . . . . . 501

Identification of defect structures in $Eu^{3+}:CaF_2$ by site selective spectroscopy of relaxation dynamics
K.M. Cirillo-Penn and J.C. Wright . . . . . 505

Optical properties of $Nd^{3+}$ and $Dy^{3+}$ ions in $ZnF_2$-$CdF_2$ based glasses
R. Cases, M.A. Chamarro, R. Alcala and V.D. Rodriguez . . . . . 509

Optical spectroscopy of monovalent copper in borate glasses and Nasicon-type phosphate
B. Moine, C. Pedrini, P. Boutinaud, C. Parent and G. le Flem . . . . . 515

Spectroscopy and dynamics of upconversion in $Tm^{3+}:YLiF_4$
M. Dulick, G.E. Faulkner, N.J. Cockroft and D.C. Nguyen . . . . . 517

On the uranyl ion luminescence in aqueous solutions
M.E.D.G. Azenha, H.D. Burrows, S.J. Formosinho, M.G.M. Miguel, A.P. Daramanyan and I.V. Khudyakov 522

On the correlation between energy structure and the mechanism of recombination for rare earth ions in solids
K. Świątek, A. Suchocki and M. Godlewski . . . . . 527

High resolution laser spectroscopy of rare earth doped $CsCdBr_3$
J.P. Chaminade, R.M. Macfarlane, F. Ramaz and J.C. Vial . . . . . 531

**Section 9. Transition metal ions in insulators**

Fluorescence line narrowing of $Cr^{3+}$ ions in sodium $\beta$ and $\beta''$-alumina crystals
T. Beltrame, G. Mariotto, M. Montagna and F. Rossi . . . . . 537

Luminescence from $Cr^{3+}$ centres in forsterite ($Mg_2SiO_4$)
T.J. Glynn, G.F. Imbusch and G. Walker . . . . . 541

Luminescence from $Fe^{3+}$ ions in octahedral sites in $LiGa_5O_8$
G. O'Connor, C. McDonagh and T.J. Glynn . . . . . 545

Luminescence of Rh(III) chelate complexes
M.G. Colombo, A. Zilian and H.U. Güdel . . . . . 549

Luminescence of the new elpasolite $Rb_2KGaF_6$ doped with $Cr^{3+}$
C. Marco de Lucas, F. Rodríguez, J.M. Dance, M. Moreno and A. Tressaud . . . . . 553

Luminescence study of $ZnGa_2O_4:Co^{2+}$
T. Abritta and F.H. Blak . . . . . 558

Site selective spectroscopy and fluorescence line narrowing of trivalent chromium impurities in $Na_3Li_3In_2F_{12}$ garnet
D. de Viry, O. Pilla, F. Pellé and B. Blanzat . . . . . 561

Spectroscopy of $Ni^{2+}$-doped garnets and perovskites for solid state lasers
J. Koetke, G. Huber and K. Petermann . . . . . 564

Photoluminescence of $Ni^{2+}$ ions in $RbCdF_3$ and $RbCaF_3$
R. Alcala, J.C. Gonzalez, B. Villacampa and P.J. Alonso . . . . . 569

Elastic relaxation around excited $Cr^{3+}$ ions in ED-2 silicate glass
U. Hömmerich and E. Strauss . . . . . 574

Optical properties of chromium (III) in fluoride glasses
M.A. Illarramendi, R. Balda and J. Fernández . . . . . 579

Optical spectroscopic properties of the pure hexagonal $V^{3+}$-halide elpasolites: $Cs_2LiVBr_6$, $Cs_2LiVCl_6$ and $Rb_2LiVCl_6$
U. Oetliker and H.U. Güdel . . . . . 584

**Section 10. Other insulators**

Auger-free luminescence excitation spectra in CsCl and CsBr between 50 and 140 eV
S. Kubota, M. MacDonald and I.H. Munro . . . . . 589

Luminescent properties of CaS:Cd phosphors
I.V.F. Viney, A.G.J. Green, J.W. Brightwell and B. Ray . . . . . 593

Temperature effect of the luminescence band at 300 nm from $BaF_2$ crystals
C.-S. Shi, T. Kloiber and G. Zimmerer . . . . . 597

Some aspects of the photoluminescence properties of solid argon
M. Joppien, F. Grotelüschen, T. Kloiber, M. Lengen, T. Möller, J. Wörmer, G. Zimmerer, J. Keto, M. Kykta and M.C. Castex . . . . . 601

Temperature dependence of the X-ray induced luminescence of quartz crystals
A. Halperin . . . . . 606

Formation and electronic energies of the matrix-isolated hydrogen–noble gas molecule
F. Wittl, M. Creuzburg and R. Schriever . . . . . 611

Luminescence and photochemistry of XeF in Ar crystals for laser applications
G. Zerza, R. Kometer, G. Sliwinski and N. Schwentner . . . . . 616

Charge transfer excitations of doped rare gas matrices
H. Kunz, J.G. McCaffrey, M. Chergui, R. Schriever, Ö. Ünal and N. Schwentner . . . . . 621

Luminescence of rare gas atoms in rare gas matrices
M. Schwoerer-Böhning, T. Kloiber, W. Laasch, T. Tochtrop, D. Varding and G. Zimmerer . . . . . 626

**Section 11. Bulk semiconductors**

Emission properties of amorphous silicon and carbon films
R.C. Fang . . . . . 631

Characterization of band tail states in amorphous silicon alloys by temperature dependent photoluminescence
T. Muschik, R. Schwarz and F. Karg . . . . . 636

Compositional dependence of photoluminescence spectra in hydrogenated amorphous silicon–sulfur alloys
T. Muschik, R. Schwarz, M. Hammam, S.M. Al-Alawi, S. Al-Dallal, S. Aljishi, M. Stutzmann and S. Jin . . . 641

Inverse photoemission of GaSe
F. Coletti, R. Hafsi, J.M. Debever and A. Chevy . . . . . 645

Luminescence investigations performed on differently prepared thin CdS layers
C. Bouchenaki, B. Ullrich and J.P. Zielinger . . . . . 649

II–VI compounds codoped with transition metals and rare earths
D. Hommel, H. Hartmann, W. Busse, H.-E. Gumlich and J. Kreissl . . . . . 655

Measurements of polarization memory of localized states in $CdS_{1-x}Se_x$ mixed crystals
H. Schwab, V. Lyssenko, A. Reznitsky and C. Klingshirn . . . . . 661

Photoluminescence of Mg-doped p-type GaN and electroluminescence of GaN p–n junction LED
I. Akasaki, H. Amano, M. Kito and K. Hiramatsu . . . . . 666

Red emission in Mn doped GaP
T. Monteiro and E. Pereira . . . . . 671

Spin-polarisation effects in luminescence
H.-J. Schulz . . . . . 675

Strong and very strong covalency effects on the lifetime of $Mn^{2+}$ in II–VI compounds
D. Boulanger, D. Curie and R. Parrot . . . . . 680

Photovoltaic characteristics of a $ZnS_xSe_{1-x}$/GaAs heterojunction with gradually changed $x$
J.f. Wang and X.r. Xu . . . . . 685

Zeeman spectroscopy of $V^{3+}$-luminescence in ZnO
R. Heitz, A. Hoffmann, B. Hausmann and I. Broser . . . . . 689

Zeeman and piezospectroscopy of the $Cu^{2+}$-center in CdS
I. Broser, A. Hoffmann, R. Heitz and P. Thurian . . . . . 693

**Section 12. Semiconducting microstructures**

Optical properties of small period superlattices
A. Chomette, B. Deveaud, F. Clérot, B. Lambert and A. Regreny . . . . . 699

Size-dependent homogeneous broadening of confined excitons in CuCl microcrystals
T. Itoh and M. Furumiya . . . . . 704

Recombination luminescence quenching of nonstoichiometric CdS clusters by trivalent lanthanide ions
J. Chrysochoos . . . . . 709

Excitonic polariton effects in an optical waveguide with a quantum well
K. Oimatsu, T. Iida, H. Nishimura, K. Ogawa and T. Katsuyama . . . . . 713

Exciton dynamics in GaAs/AlGaAs multiple quantum well structures
D. Oberhauser, H. Kalt, W. Schlapp, H. Nickel and C. Klingshirn . . . . . 717

Observation of propagation of exciton–polaritons along stacking fault plane in layered crystal $BiI_3$
T. Kawai, S. Shimanuki, T. Karasawa, I. Akai, T. Iida and T. Komatsu . . . . . 721

Photoluminescence in GaAs–AlGaAs coupled double quantum wells in electric and magnetic fields
C.H. Perry, K.-S. Lee, L. Ma, F. Lu, J.M. Worlock, J.E. Golub, E.S. Koteles and B.S. Elman . . . . . 725

Type II indirect gap superlattices under intense optical excitation
J.L. Mackay, M.D. Sturge, M.-H. Meynadier, M.C. Tamargo and J.L. de Miguel . . . . . 731

Photoluminescence of CdS/CdSe wurtzite superlattices and evidence for type II behaviour modified by piezoelectric fields
M.P. Halsall, J.J. Davies, J.E. Nicholls, B. Cockayne and P.J. Wright . . . . . 735

Excitonic properties of $ZnSe/Zn_{1-x}Cd_xSe$ strained layer quantum wells
H.J. Lozykowski and V.K. Shastri . . . . . 740

Fluorescence mechanism of highly monodisperse Q-sized CdS colloids
A. Eychmüller, A. Hässelbarth, L. Katsikas and H. Weller . . . . . 745

Luminescence study of CdTe/(Cd, Mn)Te-MQW structures in magnetic fields
W. Heimbrodt, O. Goede, H.-E. Gumlich, H. Hoffmann, U. Stutenbäumer, B. Lunn and D.E. Ashenford . . 750

Picosecond and cw luminescence studies of $CdTe/Cd_{1-x}Mn_xTe$ MQWs
M.J. McNamee, W. Hayes, D.J. Mowbray, J.F. Ryan, D.E. Ashenford and B. Lunn . . . . . 755

Symmetry of the lowest conduction band states in very short-period GaAs-AlAs superlattices
W. Ge, W.D. Schmidt, M.D. Sturge, L.N. Pfeiffer and K.W. West . . . . . 759

Separation of non-radiative and below-gap emission lifetimes in a heavily Si-doped GaAs/AlGaAs quantum well
N. Kamata, K. Yamada, H. Tsuchiya, H. Katahama, Y. Shakuda and T. Suzuki . . . . . 763

X–Γ scattering in GaAs/AlAs short-period superlattices
F. Minami, T. Nakayama and K. Inoue . . . . . 768

Electron beam excitation of II–VI compound strained layer superlattices
C. Trager-Cowan, P.J. Parbrook, D. Clark, G. Green, A.B. Wiseman, B. Henderson, K.P. O'Donnell, B. Cockayne and P.J. Wright . . . . . 773

**Section 13. Defects in crystals**

$(F_2^+)_H$-centers in doped alkali halides. Production and optical properties
G. Lifante, P. Silfsten, F. Cusso, J. García-Solé, F. Jaque and B. Henderson . . . . . 779

F-centre luminescence from $BaF_2$
T.J. Glynn . . . . . 783

Colour centres in calcium sulphide and strontium sulphide single crystals
J. Rennie, K. Takeuchi, Y. Kaneko and T. Koda . . . . . 787

Luminescence of aggregate color centers in KF
R. Coluzzi, M. Rossi, A. Scacco, F. Somma, G. Baldacchini, M. Cremona, R.M. Montereali and R.B. Pode . 792

Luminescence of defect centres in electroreduced single crystals of yttria-stabilized zirconia
C. Bonola, P. Camagni, N. Omenetto and G. Samoggia . . . . . 797

Anti-Stokes emission related to EL2 in GaAs
Y. Mori, K. Onozawa, H. Ohkura and Y. Chiba . . . . . 800

Microwave-induced line-narrowing of the N–V defect absorption in diamond
E. van Oort, B. van der Kamp, R. Sitters and M. Glasbeek . . . . . 803

Time resolved study of photoluminescence from $O_2^-$ molecules in alkali halides
S. Hongo, H. Murata and R. Kato . . . . . 807

Luminescence from surface $CN^-$ centers created photochemically on alkali halide crystals
H. Nakagawa, A. Fukumoto, A. Ohnishi, K. Fukui, H. Matsumoto, M. Fujita, T. Miyanaga and M. Watanabe 811

Delayed luminescence of the $H_3$ centre in diamond
E. Pereira and T. Monteiro . . . . . 814

Thermally stimulated luminescence applied to high-temperature superconductivity research
D.W. Cooke, M.S. Jahan, E.R. Gray, J.L. Smith, B.L. Bennett, W.L. Hults and M.A. Maez . . . . . 819

Thermally stimulated luminescence from high-temperature superconducting films and substrates
M.S. Jahan, D.W. Cooke, E.R. Gray, J.L. Smith, A. Mayer, W.L. Hults, B.L. Bennett and M.A. Maez . . . . 823

Study of low temperature luminescence and thermoluminescence in calcium fluoride crystals
K. Chakrabarti, V.K. Mathur, R.J. Abbundi, N. Kristianpoller and W.F. Hornyak . . . . . 828

Sensitization of thermoluminescence in synthetic quartz – heat treatment and radiation effects
R. Chen, M. Abu-Rayya and N. Kristianpoller . . . . . 833

**Section 14. Lasers, up-conversion and other topics**

The construction of light emitting diodes on the base of wide gap II–VI semiconductor compounds
A.N. Georgobiani . . . . . 839

Luminescence of high-temperature yttrium-based superconductors
V.G. Stankevich, N.Yu. Svechnikov, K.V. Kaznacheev, R.A. Kink, I.L. Kuusmann, E.Kh. Feldbach, G. Zimmerer, T. Kloiber, A.A. Zhokhov, G.A. Emel'chenko, M.A. Kalyagin and V.Ya. Kosyev . . . . . 845

Emission spectra observed in laser ignited explosive decomposition reaction of organometals
M. Fujita and N. Shimo . . . . . 849

A solid state laser at 4.96 $\mu$m: CO in crystalline $N_2$
H. Dubost, R. Charneau, M. Chergui and N. Schwentner . . . . . 853

Dynamics of laser-pumped $Nd^{3+}$ laser media at high excitation density
J.H. Schloss, L.L. Chase and L.K. Smith . . . . . 857

Radiation pattern of fluorescence from surface adsorbed dye molecules
H. Sano, G. Mizutani and S. Ushioda . . . . . 863

Enhancement of the upconversion efficiency in the presence of Ce ions
N. Pelletier-Allard and R. Pelletier . . . . . 867

Evanescent luminescence and nanometer-size light source
R. Kopelman, K. Liebermann, A. Lewis and W.h. Tan . . . . . 871

Visible up-converted superfluorescence in $Tm^{3+}$ doped fibers
A.S.L. Gomes and Cid.B. de Araújo . . . . . 876

An EL device of spatial separation of carrier acceleration and excitation
G. Lei, Z. Xu and X. Xu . . . . . 881

Optically pumped lasing in ZnSe epilayers grown by OMVPE
B.J. Yang, H. Tian and X.W. Fan . . . . . 884

Stimulated emission in MOVPE-grown GaN film
H. Amano, T. Asahi, M. Kito and I. Akasaki . . . . . 889

Green-luminescent (La, Ce)$PO_4$:Tb phosphors for small size fluorescent lamps
N. Hashimoto, Y. Takada, K. Sato and S. Ibuki . . . . . 893

Stable solid-state tunable lasers in the visible
R. Reisfeld and G. Seybold . . . . . 898

Closing remarks . . . . . 901

Author index to parts I and II . . . . . 903

Subject index to parts I and II . . . . . 920

Materials index to parts I and II . . . . . 930